College of Physical and Engineering Science

STAT *2230: Biostatistics for Integrative Biology (0.5 credit)
Course Outline for Winter 2021

Disclaimer:
Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website https://news.uoguelph.ca/2019-novel-coronavirus-information and circulated by email.

Illness:
The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.

I. General Information

Calendar description: This course introduces students to the design, completion and interpretation of research projects, including identifying categories of research questions, types of data, data gathering methods, efficient graphic and numeric methods to summarize data, standard statistical analyses involving parameter estimation and hypothesis tests and interpreting results in the context of research goals. Statistical concepts underlying practical aspects of biological research will be emphasized. Computer-intensive laboratory sessions will focus on practical data organization, visualization, statistical analysis using software, and interpretation and communication of statistical results. Department of Mathematics and Statistics and Department of Integrative Biology.

Prerequisite(s): BIOL*1070, BIOL*1080
Restriction(s): BIOL*2250, STAT*2040, STAT*2060, STAT*2080, STAT*2120, STAT*2250. Enrollment restricted to the BSC majors in BIOD, ECOL, MFB, WBC, WLB, ZOO and BSES majors in ECOL and ECOLC.

Instructor: Prof. Christina Caruso, Department of Integrative Biology
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Office hours: Immediately after lectures and by appointment

Instructor: Prof. Faisal Khamis, Department of Mathematics & Statistics
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Lecture: 11:30-12:20 MWF
Synchronous lectures will be delivered using Zoom and Virtual Classroom on the Courselink. All lectures will be recorded and posted on Courselink for later viewing.

Labs: 1:30-3:20 Th (*0101)
3:30-5:20 Th (*0102)
9:30-11:20 F (*0103)
12:30-2:20 F (*0104)
Synchronous labs will be delivered by the TAs using Zoom. TAs will deliver a brief introduction to that week's assignment, and then will be available to answer questions.

Midterm exam: February 26, 2021. Online open-book exam delivered using Crowdmark. You can complete the exam in any 90-minute period between 11:00 am and 6:00 pm ET.

Final exam: April 16, 2021. Online open-book exam delivered using Crowdmark. You can complete the exam in any 120-minute period between 8:30 am and 3:30 pm ET.

Problems in exams?
If you encounter any technical issues, such as internet and/or computer, contact the CourseLink Support at courselink@uoguelph.ca or 519-824-4120 ext. 56939 or 1-866-275-1478 (toll-free in Canada and US). Please do not contact your instructors because they are not able to help you in solving these issues.

II. Learning outcomes

This course is designed to give students experience and confidence in the design and analysis of data within realistic biological research contexts. Students will gain basic practical experience in displaying, summarizing, analyzing and interpreting biological data in applied research contexts using standard statistical methods.

At the end of this course students should:

1. Understand the statistical concepts of bias, variability, and sampling distributions.
2. Select the appropriate statistical method for a given data set.
3. Evaluate the quality of data collected from observational and experimental studies.
4. Make and interpret visual summaries of data.
5. Use statistical computer software to explore and analyze data.

6. Understand statistical language as used in the primary biological literature.
7. Interpret statistical results and communicate them to other biologists.

III. Course content

Our schedule of lectures is as follows:

Date	Topic	Readings from Samuels et al.
Week 1 (Jan 11-15)		
Monday Jan 11 (CC)	Why do you need statistics? Sources of variability	None
Wednesday Jan 13 (CC)	Types of evidence Sampling	Chapter 1
Friday Jan 15 (CC)	Types of evidence Sampling	Chapter 1
Week 2 (Jan 18-22)		
Monday Jan 18 (CC)	Description of samples	Chapter 2
Wednesday Jan 20 (CC)	Description of samples	Chapter 2
Friday Jan 22 (CC)	Description of samples	Chapter 2
Week 3 (Jan 25-29)		
Monday Jan 25 (FK)	Normal distribution	Chapter 4
Wednesday Jan 27 (FK)	Confidence intervals	Chapter 6
Friday Jan 29 (FK)	Confidence intervals	Chapter 6
Week 4 (Feb 1-5)		
Monday Feb 1 (FK)	Bias and precision One-sample hypothesis tests	Chapter 6
Wednesday Feb 3 (FK)	Bias and precision One-sample hypothesis tests	Chapter 6
Friday Feb 5 (FK)	Bias and precision One-sample hypothesis tests	Chapter 6
Week 5 (Feb 8-12)		
Monday Feb 8 (CC)	Experimental design I Comparison of two independent samples	Chapter 7
Wednesday Feb 10 (CC)	Experimental design I Comparison of two independent samples	Chapter 7
Friday Feb 12 (CC)	Comparison of paired samples	Chapter 8
BREAK (Feb 15-19)	NO CLASS	
Week 6 (Feb 22-26)		
Monday Feb 22 (CC)	Review	None
Wednesday Feb 24 (FK)	Review	None
Friday Feb 26	Online Midterm Exam (90 min)	None
Week 7 (Mar 1-5)		

Monday Mar 1 (FK)	Chi-square goodness of fit test	Chapter 9
Wednesday Mar 3 (FK)	Chi-square goodness of fit test	Chapter 9
Friday Mar 5 (FK)	Contingency tables	Chapter 10
Week 8 (Mar 8-12)		
Monday Mar 8 (CC w/GH)	Experimental design II	None
Wednesday Mar 10 (CC w/GH)	Experimental design II One-way ANOVA	Chapter 11
Friday Mar 12 (CC w/GH)	One-way ANOVA	Chapter 11
Week 9 (Mar 15-19)		
Monday Mar 15 (FK)	Multiple comparisons	Chapter 11
Wednesday Mar 17 (FK)	ANOVA w/blocks	Chapter 11
Friday Mar 19 (FK)	ANOVA w/blocks	Chapter 11
Week 10 (Mar 22-26)		
Monday Mar 22 (CC)	Two-way ANOVA	Chapter 11
Wednesday Mar 24 (CC)	Two-way ANOVA	Chapter 11
Friday Mar 26 (FK)	Linear regression and correlation	Chapter 12
Week 11 (Mar 29-Apr 2)		
Monday Mar 29 (FK)	Linear regression and correlation	Chapter 12
Wednesday Mar 31 (FK)	Linear regression and correlation	Chapter 12
Friday Apr 2	Good Friday: Class rescheduled for Apr 12	None
Week 12 (Apr 5-9)		
Monday April 5 (FK)	Linear regression and correlation	Chapter 12
Wednesday Apr 7 (CC)	Case studies	None
Friday Apr 9 (CC)	Review	None
Monday Apr 12 (FK)	Review	None
Friday Apr 16	Online Final Exam (120 min)	None

Our schedule of labs is as follows:

Date	Topic of lab	Due date for lab
Week 1 (Jan 11-15)	No lab	N/A
Week 2 (Jan 18-22)	Lab 1: Introduction to R	N/A (lab is ungraded)
Week 3 (Jan 25-29)	Lab 2: Sampling Description of samples	Feb 1
Week 4 (Feb 1-5)	Lab 3: Confidence intervals	Feb 8
Week 5 (Feb 8-12)	Lab 4: One-sample hypothesis tests	Feb 15
BREAK (Feb 15-19)	BREAK	N/A
Week 6 (Feb 22-26)	No lab	N/A

Week 7 (Mar 1-5)	Lab 5: Experimental design Comparison of independent and paired samples	Mar 8
Week 8 (Mar 8-12)	Lab 6: Chi-square tests	Mar 15
Week 9 (Mar 15-19)	Lab 7: Experimental design One-way ANOVA Multiple comparisons	Mar 22
Week 10 (Mar 22-26)	Lab 8: ANOVA w/blocks Two-way ANOVA	Mar 29
Week 11 (Mar 29-Apr 2)	No lab because of Good Friday holiday	N/A
Week 12 (Apr 5-9)	Lab 9: Regression Correlation	Apr 12

Important Dates

Jan. 11	First day of classes
Jan. 11	First lecture
Jan. 21-22	First lab
Feb. 15-19	Reading week
Feb. 26	Midterm
Apr. 12	Last day of classes
Apr. 16	Final Exam

IV. Course Resources

Recommended resources

Textbook: Samuels, M.L., J. A. Witmer, and A. A. Schaffner. 2016. Statistics for the Life Sciences, Fifth Edition. New York, Prentice Hall.

Samuels et al. (2016) is available for purchase at the University and Co-op Bookstores. We will assign readings and practice problems from Samuels et al. (2016). You will also be able to use it during the open-book midterm and final exam.

R statistical software: We will be using the software package RStudio to analyze data in labs. R is freely available. Downloading R is a two-step process:

1. Download R (the programming language) at http://cran.r-project.org.
2. Download RStudio (the visual interface) at https://www.rstudio.com/products/rstudio/download/.

To launch R, always click on the RStudio icon and not the R icon.

Guide to using R: Dalgaard, P. 2008. Introductory Statistics with R, Second Edition. New York, Springer.

A PDF of Dalgaard (2008) is available for free download on Courselink.

V. Methods of Assessment

Assessment		**Due Date**
Lab assignments	40%	Weekly (Learning outcomes #1-7)
Midterm Exam	25%	February 26th (Learning outcomes #1, 3, 4, and 7)
Final Exam	35%	April 16th (Learning outcomes #1-5, 7)

Lab assignments: The assignments are designed to give you experience in data management, experimental design, graphical methods, and statistical analysis using R, as well as reinforce concepts presented in lectures. The assignments and any required data sets will be posted on Courselink. Assignments will be due by noon on Mondays. **Late assignments will not be accepted, but your lowest assignment grade will be dropped.**

We encourage you to discuss the assignments with your peers, as this leads to better understanding. However, statistical analysis, data exploration, and the learning of statistical software only comes with experience. Consequently, you will get the best value if you work with your peers to increase your comprehension, rather than to do less work.

Each student must hand in a separate complete assignment, and no part of this should be copied from another student. Academic dishonesty, such as plagiarism (including copying all or part of an assignment) and impersonation is grounds for loss of course credit and dismissal. More information on the subject of academic misconduct can be found at:

http://www.uoguelph.ca/undergrad_calendar/c08/c08-amisconduct.shtml.

You will be submitting completed assignments online using a grading software called Crowdmark. You will receive online submission instructions via your University of Guelph e-mail address for each assignment. It is your responsibility to check for this e-mail and to contact Prof. Caruso if you do not receive the e-mail for a particular assignment. More details regarding this process will be provided on each assignment. Marked assignments will be returned via e-mail.

You are responsible for answering all of the questions on each assignment because they will help prepare you for the course exams. However, only some of the questions on each assignment will be graded each week. You will not know in advance which questions will be subject to grading. Solutions for each assignment will be posted on the course. It is up to you to check the answer sheet to evaluate your performance on the unmarked questions.

Exams: There will be one midterm and one final exam in the course. Students are allowed to use their notes, copies of assignments, a calculator, and the course textbook during the midterm and final. However, they cannot communicate with their peers or any other people during the exam.

If you missed the midterm because of illness or academic consideration, your final exam will be reweighted to make up for the missed test. If you miss the final exam for any reason, you must see your program counsellor. University regulations require specific procedures to be followed regarding the conduct of final exams, including recourse, if any, for missed final examinations. These procedures are out of the course instructors' control.

VI. Course Policies

Recording of Materials: Presentations that are made in relation to course work – including lectures – cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

E-mail Communication: As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement: When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructors (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The University will not require verification of illness (doctor's notes) for Winter 2021 courses. However, requests for academic consideration may still require medical documentation and consultation with your program counsellor. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar:

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml.

Drop Date: Students will have until the last day of classes (Monday, Apr 12) to drop courses without academic penalty. Review the Undergraduate Calendar for regulations and procedures for Dropping Courses:

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Copies of Assignments: Keep paper and/or other reliable back-up copies of all assignments: you may be asked to resubmit work at any time.

Accessibility: The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

For more information, contact Student Accessibility Services at 519-824-4120 ext. 56208 or email accessibility@uoguelph.ca.

Resources: The Academic Calendars are the sources of information about the University of Guelph's procedures, policies and regulations that apply to undergraduate, graduate and diploma programs: https://www.uoguelph.ca/registrar/calendars.

Academic misconduct: The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Online Behaviour: Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

· Posting inflammatory messages about your instructor or fellow students
· Using obscene or offensive language online
· Copying or presenting someone else's work as your own
· Adapting information from the Internet without using proper citations or references
· Buying or selling term papers or assignments
· Posting or selling course materials to course notes websites
· Having someone else complete your quiz or completing a quiz for/with another student
· Stating false claims about lost quiz answers or other assignment submissions
· Threatening or harassing a student or instructor online
· Discriminating against fellow students, instructors and/or TAs
· Using the course website to promote profit-driven products or services
· Attempting to compromise the security or functionality of the learning management system
· Sharing your user name and password
· Recording lectures without the permission of the instructor

Recording of Lecture Materials: The University of Guelph's primary mode of course delivery has shifted from face-to-face instruction to remote and online learning due to the ongoing COVID-19 pandemic. As a result, some learning activities (e.g., synchronous lectures or student presentations) may be recorded by faculty, instructors and TAs and posted to CourseLink for grading and dissemination; students may be recorded during these sessions.

By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other "live" course activities, whether delivery is in-class or online/remote.

If a student prefers not to be distinguishable during a recording, they may:

1. turn off their camera
2. mute their microphone
3. edit their name (e.g., initials only) upon entry to each session
4. use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.

Personal information: Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/index.html. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes. For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar:

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml

VII. Campus Resources

If you are struggling to succeed academically

Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.

http://www.learningcommons.uoguelph.ca/

Science Commons: Located in the library, the Science Commons provides support for physics, mathematics/statistics, and chemistry. Details on their hours of operations can be found at:

http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help

and

http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help

If you are struggling with personal or health issues

Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance:

https://www.uoguelph.ca/counselling/.

Student Health Services is located on campus and is available to provide medical attention:

https://www.uoguelph.ca/studenthealthservices/clinic.